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Pesticide Fact Sheet No. 223: Dithiopyr

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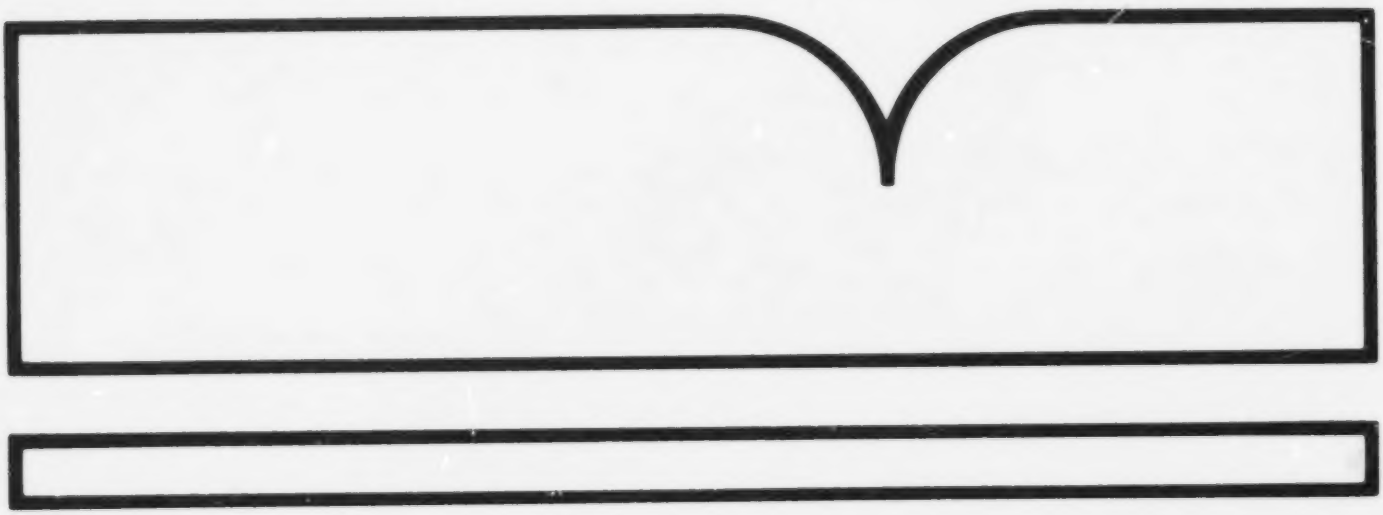

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16. Abstract (Limit: 200 words)

This document contains up-to-date chemical information, including a summary of the Agency's regulatory position and rationale, on a specific pesticide or group of pesticides. A Fact Sheet is issued after one of the the following actions has occurred.

1. Issuance or reissuance of a registration standard,
2. Issuance of each special review document,
3. Registration of a significantly changed use pattern,
4. Registration of a new chemical, or
5. An immediate need for information to resolve controversial issues relating to a specific chemical or use pattern.

17. Document Analysis a. Descriptors

Pesticides, regulations, Chemical Information Fact Sheet, Use Patterns, science findings.

b. Identifiers/Open-Ended Terms

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EPA

Pesticide Fact Sheet

Name of Chemical:	Dithiopyr
Reason for Issuance:	Registration
Date Issued:	June 18, 1991
Fact Sheet Number:	223

1. DESCRIPTION OF CHEMICAL

Generic Name: 3,5-Pyridinedicarbothioic acid, 2-(difluoromethyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-S,S-dimethyl ester
Common Name: MON-7200, MON-15100 and Dithiopyr
Trade Names: Dimension® Turf Herbicide
EPA Shaughnessy Code: 128994-1
Chemical Abstracts Service (CAS) Number: 97886-45-8
Year of Initial Registration: 1991
Pesticide Type: Herbicide
Chemical Family: Pyridine
U.S. Producer: Monsanto Company

2. USE PATTERNS AND FORMULATIONS

Application sites: Terrestrial non-food sites. Preemergence and early postemergence for selective control of crabgrass and other susceptible annual grasses and broadleat weeds in established lawns and ornamental turf.

Types of formulations: The two end-use products are liquid emulsitied suspensions ot the active ingredient; with nominal concentrations of 12.7% (MON 15151 EC Herbicide) and 13.2% (MON 15104 EC Herbicide). Acute toxicity studies were with formulatons containing 12.5%, and were within the limits of variation for these products.

Amount and Method of Application: A single application of 0.50 lb. active ingredient per acre per season is claimed for both preemergence and postemergence selective weed control in the culture of turf. Ground spray application ot an aqueous suspension is the only method of application registered.

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3. SCIENCE FINDINGS

Summary Science Statements:

Adequate toxicological, product chemistry, ecological effects, environmental fate and ground water data have been submitted and reviewed to support the conditional registration of dithiopyr for use as a preemergence and postemergence herbicide in the culture of ornamental turf grasses. Technical dithiopyr is classified as a Toxicity Category IV pesticide and is labeled with the signal word "CAUTION", based on a battery of 6 acute studies.

Dithiopyr was non-mutagenic and in developmental toxicity studies it did not appear to be a potential developmental toxicant. Ecological effects data characterize dithiopyr as practically nontoxic to birds on subacute dietary and acute oral bases. Toxicological data demonstrate that it is of low acute toxicity to mammals. A subchronic 90-day feeding study in rats indicated a no observable effect level (NOEL) of 0.662 mg/kg/day. At the 6.62 mg/kg/day there was an increase in organ weights and diffused hepatocellular swelling. It has little to no potential for ground water contamination. It is stable to hydrolysis in neutral and mildly alkaline solutions. At pH 9 it had a half-life of 1053 days based on first order kinetics. Photodegradation in water could contribute significantly to the overall degradation of dithiopyr in the environment. Photodegradation of dithiopyr on soil is insignificant. Therefore, photodegradation on soil will not contribute significantly to its degradation in the environment.

Chemical Characteristics:

Physical State:	Solid, crystalline
Color: Chemically Pure:	White
Technical Grade:	Yellow to Burnt Yellow
Odor:	Sulfurous
Melting Point:	65-67° C
Density:	1.413 gm/cm^3 at 25° C (typical)

Molecular Weight 401.4

Solubility	Solvent			at °C
Parts per Million:	Water		1.38	20° C
Grams per 100 ml:	Hexane	<	3.30	25° C
	Toluene	>	25.00	25° C
	Acetone	>	33.30	25° C
	Diethyl ether	>	50.00	25° C
	Ethanol	>	12.00	25° C
	Methylene chloride	>	50.00	25° C

Vapor Pressure: 4.0×10^{-6} mm/Hg at 25°C

Dissociation Constant: Not required, Dithiopyr is not an acid

Octanol/Water Partition Coefficient: $P = 5.625 \times 10^{4}$

pH: (in non-aqueous solvent): 4.152

Stability

Less than 1% change in assay was observed after 14 days of exposure to sunlight, 14 days of exposure to Cu, Zn and Fe, 14 days of exposure to a temperature of 50° C. The formulated end use product (MON-15151 EC Herbicide) was stable stored 12 months at 68 and 80°F. Only a change of 0.37% in quantity of active ingredient occurred.

Toxicology Characteristics:

Acute Toxicity (90.9%, Technical, MON-7200/MON 15100)

Acute oral toxicity (rats and mice): LD_{50} > 5000 mg/kg, Toxicity Category IV.

Acute dermal toxicity (rat): LD_{50} > 5,000 mg/kg, Toxicity Category IV.

Primary dermal irritation (rabbit): Slight erythema but no edema within 0.5 hours. No effects by 72 hours. Toxicity Category IV.

Primary eye irritation (rabbit): No corneal opacity; irritation reversible within 24 hours. Toxicity Category IV.

Acute inhalation toxicity (rat): LC_{50} > 5.89 mg/L for

males and females (nose exposure only). Toxicity Category IV.

Dermal sensitization (guinea pig): Not a dermal sensitizer by the Buehler method.

Acute Toxicity (12.5% a.i., Dimension Turf Herbicide, MON-15151)

Acute oral toxicity (rats): LD_{50} = 4100 mg/kg for males and 3,000 for females. Toxicity Category III.

Acute dermal toxicity (rats): No deaths, LD_{50} >5000 mg/kg, Category IV.

Primary dermal irritation (rabbit): Severe dermal irritation. Superficial (epidermis) necrosis, clearing within 14 days. Category II.

Primary eye irritation (rabbit): Corneal corrosion reversible with 21 days, and possibly within 7 days; corneal opacity reversible within 7 days. Category II.

Acute inhalation toxicity (rat): LC_{50} = 11 mg/L for males. LC_{50} = 8.9 mg/L for females. Category IV.

Dermal sensitization (guinea pig): Positive for dermal sensitization by Buehler method.

Acute Toxicity (12.5% a.i., Dimension Turf Herbicide, MON-15104)

Acute oral toxicity (rat): LD_{50} > 5000 mg/kg for males and females. Toxicity Category IV.

Acute dermal toxicity (rabbit): LD_{50} > 5000 for males and females. Toxicity Category IV.

Primary dermal irritation (rabbit): Very slight or slight irritation at 72 hours, clearing within 10 days. Toxicity Category IV.

Primary eye irritation: (rabbit): No corneal opacity; irritation reversible within 24 hours. Toxicity Category IV.

Acute inhalation toxicity (rat): LC_{50} > 3.4 mg/L for males and > 4.5 mg/L for females. Toxicity Category III.

Dermal sensitization (guinea pig): Not a dermal sensitizer by the Buehler method.

Subchronic Toxicity

A 21-day dermal study in rats was conducted using levels of 0, 50, 500 and 1,000 mg/kg/day. Limited to transient mild irritation occurred in all dose groups. Incidence was generally dose-related and higher in females than in males. The NOEL was 500 mg/kg/day and the LEL was 1000 mg/kg/day.

In a rat developmental toxicity study there were no developmental effects at 1000 mg/kg/day (HDT). Maternal effect was decreased food consumption. The NOEL for this effect was 300 mg/kg/day and the LEL was 1000 mg/kg/day.

In a rabbit developmental toxicity study there were no developmental effects at 1000 mg/kg/day (HDT). Maternal effect was reduced body weight gain. The NOEL for this effect was 500 mg/kg/day and the LEL was 1000 mg/kg/day.

In a 90-day subchronic study in rats a NOEL of 0.662 mg/kg/day was indicated based on an LOEL of 6.62 mg/kg/day in females. The effect was an increase in organ weight and diffused hepatocellular swelling.

Mutagenicity

The following mutagenicity studies indicated that Dithiopyr is not mutagenic at doses tested:

- Ames Assays for mutagenicity with Ames (TA) strains of Salmonella typhimurium LT2 were found negative for reverse gene mutation (his^- to his^+) at limit of solubility (3,000 ug/plate) with or without activation.

- Ames Assays for mutagenicity with Ames (TA) strains of Salmonella were found negative for reverse gene mutation (his^- to his^+) at 5,000 ug/plate with or without activation.

- Gene mutation at the HGPRT locus in Chinese hamster ovary cells exposed with or without activation up to cytotoxic dose levels: (300 ug/ml/-S9; 30 ug/ml/+S9).

- Structural chromosome aberrations in Chinese hamster lung cells exposed to the limit of solubility (0.33 and 1.0 mM).

- Unscheduled DNA synthesis (UDS) in primary rat hepatocytes (HPC), as measured by silver grain counts indicative of DNA damage/repair.

Mechanism of Pesticidal Action:

Dithiopyr is a mitotic inhibitor of normal cell division of susceptible plants. The formation and function of microtubulin is inhibited. Susceptible plant roots are stunted and fail to function in the presence of dithiopyr. Plants do not grow and develop through their normal cycle of vegetative growth followed by reproduction (flowering and seed setting). Susceptible plants react to dithiopyr in such a way as to be less competitive.

Environmental Characteristics:

Hydrolysis: Dithiopyr does not hydrolyze in neutral solutions and only slowly in alkaline solutions (pH 9). At pH 9 it has a half-life of 1053 days based on first order kinetics. Data indicate that ester hydrolysis, which appears to be the hydrolysis pathway for dithiopyr, will not be a significant route of degradation of dithiopyr in the environment.

Photodegradation: The half-life of dithiopyr in sunlight was 17.6 and 20.6 days for nonsensitized and humic acid solutions, respectively. The parent material comprised 24.5% of the applied radioactivity. The half-life of dithiopyr in soil was determined to be 444.3 days. Based on the data dithiopyr is classified as photostable in or on soil. These findings indicate that photodegradation in water could contribute significantly to the overall degradation of dithiopyr in the environment. In water dithiopyr can be expected to degrade to a mixture of normal acid, reverse acid, and lesser amounts of polar compounds upon exposure to sunlight. Photodegradation of dithiopyr on soils is insignificant. Therefore, photodegradation on soil will not contribute significantly to its degradation in the environment.

Aerobic Soil Metabolism: In aerobic soil maintained under laboratory conditions, dithiopyr degraded to the normal acid, reverse acid and diacid. The maximum concentrations of degradates were reached at 6-12 months post-treatment.

Anaerobic Soil Metabolism: An anaerobic aquatic metabolism is required and will be submitted as a condition of registration.

Field Dissipation: Dissipation occurs in the field with vegetation coverage with a half-life of between 17 and 61 days depending on soil composition, weather conditions and formulation applied. Three major metabolites of dithiopyr (the normal acid, reverse acid and diacid metabolites) are formed and dissipated within 365 days.

Leaching, Adsorption/Desorption: Vertical mobility of dithiopyr and its acid metabolites through soil, even in conditions highly susceptible to herbicide leaching, was found not to exceed 24 inches and was often not more than 9 to 12 inches. At a use rate of 0.5 lb/A of dithiopyr, metabolites could be observed at only barely or nondetectable levels. Residues should not persist beyond the growing season and would not be expected to vertically move to a significant extent in soil.

Potential to Contaminate Ground Water: The low solubility in water and its high tendency to bind to soil prevents dithiopyr from being carried downward through soil. Dithiopyr has a low potential for leaching into ground water. Surface water contamination from soil containing dithiopyr would be expected.

Ecological Characteristics

Avian Studies: Dithiopyr is practically non-toxic to birds based on the following studies:

Single Dose Oral Toxicity:
Mallard duck with 90% Technical:
LD_{50} > 2250 mg/kg

Subacute Dietary Toxicity:
Mallard duct with 90% Technical:
LD_{50} > 5620 ppm
Bobwhite quail with 90% Technical:
LD_{50} > 5620

Avian Reproduction: A study is required as a condition of registration.

Aquatic Organisms: The following data indicate that dithiopyr is highly toxic to freshwater fish and aquatic invertebrates:

Fish Acute Toxicity:
Bluegill sunfish, LC_{50} = 0.47 mg/L
Rainbow trout, LC_{50} = 0.46 mg/L

Early Life-stage Toxicity:
Rainbow trout, NOEC = 0.052 mg/L

Freshwater Invertebrates:
A supplemental study indicates that the 48 hour LC_{50} based on nominal concentration is greater than 5.6 ug/L. An acceptable study is required as a condition of registration.

Endangered Species Hazards:

Based on available data, the conditionally registered use-pattern of dithiopyr is unlikely to pose a hazard to endangered aquatic and avian species. There may be some hazard to endangered plant species from runoff and movement of the products from treated turf areas.

4. Summary of Regulatory Postion and Rationale

Available data provide adequate information to support the conditional registration of Dimension® Turf Herbicide (MON-15151), Dimension® Turf Herbicide (MON-15104) and MON-15100, that were first conditionally registered June 18, 1991 under Section 3 of the Federal Insecticide, Fungicide and Rodenticide Act as amended.

Use, Formulation, Manufacturing Process or Geographic Restrictions: Aerial applications of dithiopyr products are not permitted. All products must bear the precautionary statement: "This pesticide is toxic to fish." End-use products must bear the use precaution: "During mixing and loading wear chemical resistant gloves. Wash non-disposable gloves throughly with soap and water before removing".

Conditional registration will expire on July 31, 1994.

5. Summary of Data Gaps

Toxicology Data:
1. Dermal Penetration Study (Guidelines Ref. No. 85-2), Data are due July 18, 1992.

Exposure Data:

1. Worker Exposure Studies (Upgrade the passive dosimetry study and the biological monitoring study). Data are due September 18, 1993.

Ecological Effects Data:

1. Acute LC_{50} Freshwater Invertebrate Study, EPA Ref. Guidelines 72-2. Data are due March 18, 1992.

2. Avian Reproduction with a Waterfowl and Bobwhite Quail, EPA Ref. Guidelines 71-4. Data are due July 18, 1993.

3. Acute LC_{50} Estuarine/Marine Organisms Studies, EPA Ref. Guidelines 72-3, identified as:
   - o 96-hour LC_{50} for an estuarine marine fish
   - o 96-hour LC_{50} for a shrimp species
   - o Either a 48-hour embryo larvae study or a 96-hour shell deposition study with oyster.

   Data are due July 18, 1992.

4. Aquatic Invertebrate Life-Cycle Study, EPA Ref. Guidelines 72-4. Data are due September 18, 1992.

5. Nontarget Area Phytotoxicity:

   Tier II:
   - o Seed germination/seedling emergence, EPA Ref. Guideline 123-1
   - o Vegetative vigor, EPA Ref. Guideline 123-1
   - o Aquatic plant growth, EPA Ref. Guidelines 123-2.

   Tier III:
   - o Terrestrial Field[1], EPA Ref. Guidelines 124-1
   - o Aquatic field[2], EPA Ref. Guidelines 124-2

   1/ Required if a 25 percent or greater detrimental effect was found in 1 or more plant species in corresponding test of previous tier.

   2/ Required if a 25 percent or greater detrimental effect was found on any plant species in the corresponding test of the previous tier.

   Data are due March 18, 1992.

Environmental Fate and Ground Water Data:

1. Anerobic Aquatic Metabolism Study, EPA Ref. Guidelines 162-3. Data are due September 18, 1993.

2. Field Dissipation Study, Bare Ground, EPA Ref. Guidelines 164-1. Data are due September 18, 1993.

6. Contact Person at EPA

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